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Soil Survey
of
Carter County, Oklahoma

By

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United States Department of Agriculture, in Charge

and

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Oklahoma Agricultural Experiment Station

Bureau of Chemistry and Soils

In cooperation with the
Oklahoma Agricultural Experiment Station

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SOIL SURVEY OF CARTER COUNTY, OKLAHOMA

By E. G. FITZPATRICK, United States Department of Agriculture, in Charge, and W. C. BOATRIGHT, Oklahoma Agricultural Experiment Station

COUNTY SURVEYED

Carter County is in the south-central part of Oklahoma (fig. 1). Love County lies between it and the Texas State line. Ardmore, the county seat, is approximately 100 miles south of Oklahoma City and about 80 miles north of Fort Worth, Tex. The county includes an area of 831 square miles, or 531,840 acres. It lies in the transitional belt between the prairie land of the west and the forested land of the east and supports the types of vegetation common to both sections.

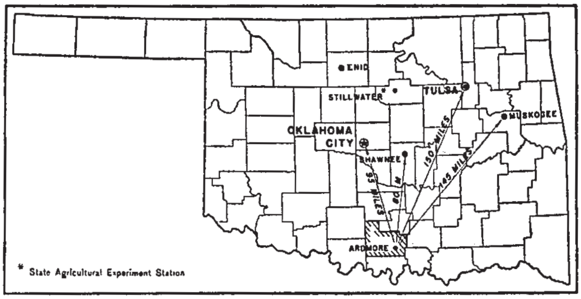

FIGURE 1.—Sketch map showing location of Carter County, Okla.

The greater part of Carter County consists of a rolling to strongly rolling forested plain which slopes gently from northwest to southeast. This plain is interrupted in several places by areas of rolling prairies, some of which are very extensive but many very small. The plain is also interrupted by two very prominent folds in the earth's crust and several smaller folds. The most important of these comprises the Arbuckle Mountains which are made up principally of limestone that has been exposed by folding and the geologic erosion of overlying formations. They are low smooth mountains extending from east to west along the northern border of the county. The other important fold, forming the Criner Hills in the southern part, extends in a northwest-southeast direction. The Criner Hills are much lower and less extensive than the Arbuckle Mountains but otherwise are similar. Both are surrounded by extensive areas of heavy Prairie soils developed from heavy shales which have been exposed to weathering by folding of the earth's crust. Several smaller folds are east of the Criner Hills. In many places, particularly east of the Criner Hills, the shales are interbedded with sandstone; and sandstone ridges alternate with shale valleys extending in a northwest-southeast direction. Another important physiographic unit is the bottom land and terraces along the principal streams, particularly in the Washita River Valley in the eastern part of the county, which range from 2 to 3 miles in width.

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The uneroded remnants of the original plain lie at an elevation of approximately 1,100 feet above sea level in the western part of the county and about 800 feet in the eastern part. The Arbuckle Mountains reach an elevation of approximately 1,250 feet. In general the main divides are not very wide, as the greater part of the original plain has been cut by streams and subjected to geologic erosion. The principal streams have cut valleys to a depth of about 150 feet. The depth of dissection is greatest in the eastern part of the county. Most of the stream valleys are wide and without steep escarpments, but a few have steep rocky sides.

Drainage waters in the southern part of the county flow into Red River. Most of the other streams flow eastward into Washita River. The drainage is dendritic except in the section where folding has taken place and the sandstone ridges force the drainageways to flow parallel to them, thus creating a trellised pattern. Practically all of the land is well drained, but the alluvial soils are intermittently subject to poor drainage.

Carter County has two distinct types of native vegetation. Before settlement by the white man, the greater part of the county was covered with forest. Large areas, however, were covered with grass. The principal trees are post oak and blackjack oak. They do not grow very large, but the stand is comparatively thick on the remaining virgin areas. Other trees are chinquapin, red, black, and bur oaks, blackhaw, hickory, pecan, persimmon, soapberry, redbud, sycamore, and willow. The undergrowth, which is not dense, consists largely of Indian currant, sumac, and haw. The principal grasses, which form a heavy sod in the prairie area, are buffalo grass, blue grama, bluestem, wire grass, and silver beardgrass. Crab, Johnson, and Bermuda grasses are common in cultivated areas. The more common weeds in cultivated fields are cocklebur, sunflower, thistle, bindweed, horsenettle, buffalo-bur, pigweed, sandbur, and ragweed. In general the heavier textured upland soils support a prairie type of vegetation and the sandy soils a forest type.

The land included in Carter County was claimed by Spain, France, and the United States.[1] It was a part of the Louisiana Purchase from France. The Chickasaws, a highly civilized tribe of Indians, ceded their lands east of the Mississippi River to the United States and received in return the land that now comprises all of Carter and several other counties and parts of counties to the east. This comprised the holdings of the Chickasaw Nation. A modern government with a constitution, governor, and two legislative houses was established in 1887. The capital was at Tishomingo, which is about 40 miles east of Ardmore. Most of the early settlement was in the eastern part of the Chickasaw Nation, and the part that is now Carter County remained unsettled for some time. One of the first persons to settle in the section which later became Carter County was a Chickasaw Indian named Adam Jimmy, who built his home about 4 miles south of the present site of Ardmore about 1862. The country was then known as Adam Jimmy's Prairie. A trail running through the area on which the city of Ardmore now stands was

[1] THORBURN, J. B. OKLAHOMA, A HISTORY OF THE STATE AND ITS PEOPLE. 4 v., illus. New York. 1929.

called Whisky Trail because of its connection with the smuggling of whisky from Texas into the Indian Territory.

At the time of the construction of the Atchison, Topeka & Santa Fe Railway across this section in 1887, the only habitation at Ardmore was the old 700 Ranch headquarters with its log cabins and barns. This ranch was established in the late seventies as headquarters for cattlemen. The advent of the railroad marked the beginning of Ardmore as a town. As the official who located the railroad stations was from Pennsylvania, he named four stations in this vicinity for towns in Pennsylvania. These stations are Berwyn, Ardmore, Overbrook, and Marietta.

Carter County, with Ardmore as the county seat, was organized in 1907 at the time Oklahoma was admitted to the Union. By 1930 it had a population of 41,419, of which 18,258 were classed as urban and 23,161 as rural. Of the total population in that year, 88.4 percent were native white, 0.5 percent foreign-born white, and 8.9 percent Negro. By 1930, the population of Ardmore had increased to 15,741. The population of Wilson in 1930 was 2,517, and that of Healdton was 2,017. Other important towns are Countyline, Milo, Lone Grove, Springer, and Berwyn.

Railroad transportation facilities are very good. The county is served by a main line of the Gulf, Colorado & Santa Fe Railway, connecting it with Oklahoma City and Fort Worth, Tex. The Ringling branch of that railway connects Ardmore with Healdton and Ringling to the west. A branch of the Chicago, Rock Island & Pacific Railway runs eastward from Ardmore.

Two important United States highways cross the county. United States Highway No. 77, a hard-surfaced road, connects Ardmore with Oklahoma City and Fort Worth, and United States Highway No. 70, a partly paved and partly graveled road, connects Ardmore with points east and west. A few of the other main roads are surfaced with gravel or oil. Secondary roads on most section lines serve as feeders to the main roads, except in the rougher areas. They are generally in fairly good condition, except during prolonged periods of dry or wet weather. Pipe lines transporting oil and gas are numerous.

Telephone communication is well developed, particularly in the western part of the county.

Several excellent consolidated schools have caused, to a large extent, the abandonment of the small school buildings. Separate schools are maintained for colored children. Carter Academy, a school for Indian girls, is located near Ardmore. Churches are numerous in most towns.

Aside from industries directly related to agriculture, the most important one in this county is the oil and gas industry. This enterprise has aided very materially in the progress of the county, as evidenced by schools, transportation facilities, and aids to communication. There are extensive oil fields in the western part, particularly in the vicinity of Healdton, Dillard, Graham, Pruitt City, Tatums, Clemscot, and Wirt. Three large oil refineries operate at Ardmore.

Several asphalt mines are located in the Criner Hills and near Woodford. Gravel pits are common, and the gravel is used for road-building material to some extent. Limestone is very abundant in the Arbuckle Mountains and the Criner Hills, but it is not utilized to a great extent. Coal mining has been attempted, but the veins dip too steeply to make this industry practical.

Some lumbering is carried on. The production of fence posts is the most important phase because of the small size attained by the principal trees.

Other industries are largely related to the utilization of agricultural products. Cotton gins are located at convenient points throughout the county. Cotton compresses, cottonseed-oil mills, mattress factories, creameries, and broom factories located at Ardmore utilize and process various agricultural products.

CLIMATE

The climate of Carter County is typical of southern Oklahoma, with its warm summers and comparatively short, mild winters, punctuated by several short cold waves or northers, which are sometimes accompanied by rain or snow. They rarely last more than 3 or 4 days. The average rainfall at Ardmore is 36.06 inches. It is fairly well distributed throughout the year. April, May, and June are the wettest months. Snow seldom remains on the ground longer than 3 or 4 days. Field work may be continued throughout most of the winter except during the short cold spells and following unusually heavy rainfalls. Destructive hailstorms occasionally cause severe damage to crops over small areas.

The average date of the first killing frost is November 11 and of the last is March 17, giving an average frost-free season of 239 days. Frost has been known to occur as early as October 18 and as late as April 17.

The county lies in the western part of the humid region where the rainfall during certain seasons is inadequate for the production of such crops as corn. During most seasons the rainfall is sufficient for the production of cotton, oats, and grain sorghums. Corn generally is successful on the bottom soils, in which additional water is supplied from overflows and run-off from the adjacent uplands. Spring-sown oats receive adequate rainfall during most seasons, but moisture is often insufficient during the fall and early winter for successful crops of wheat and fall-sown oats.

Fruit trees grow well, but occasionally late frosts damage peaches, apples, and pears. Sour cherries more often escape damage from frost. Pecans are sometimes damaged, but total failure of this crop is rare. Grapes produce practically every year.

Although Carter County is not in the dry-farming section of the State, practices to conserve moisture, such as plowing immediately after harvest and keeping down all weeds, increase crop yields.

Table 1, compiled from records of the United States Weather Bureau station at Ardmore, gives the more important climatic data for this county.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Ardmore, Carter County, Okla.*

[Elevation, 872 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1908)	Snow, average depth
	°*F.*	°*F.*	°*F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	43.5	81	4	2.07	0.09	(1)	1.2
January	42.1	89	−4	1.87	.76	1.72	2.0
February	45.5	95	−3	1.70	.97	2.85	1.7
Winter	43.7	95	−4	5.64	1.82	4.57	4.9
March	55.0	98	13	2.20	.45	2.63	.2
April	63.2	97	26	4.39	4.59	9.01	.0
May	70.0	102	32	4.70	2.01	10.40	.0
Spring	62.7	102	13	11.29	7.05	22.04	.2
June	79.0	112	45	3.79	2.76	10.93	.0
July	83.4	111	54	3.09	2.38	2.50	.0
August	83.6	111	50	2.81	2.64	.41	.0
Summer	82.0	112	45	9.69	7.78	13.84	.0
September	76.6	108	38	3.28	1.46	4.92	.0
October	64.7	98	18	3.67	.08	6.21	.0
November	53.9	93	15	2.49	1.05	3.70	.2
Fall	65.1	108	15	9.44	2.59	14.83	.2
Year	63.4	112	−4	36.06	19.24	55.28	5.3

[1] Trace.

AGRICULTURAL HISTORY AND STATISTICS

The area included in Carter County was first settled by cattlemen who grazed cattle over the open range. Indians moving westward settled along the bottom lands and cultivated small areas, in order to supplement the food obtained by hunting and fishing. Later, white men leased Indian land or intermarried with the Indians and gained the right to own land in this section. After Oklahoma became a State in 1907, the Indians were allowed to obtain possession of 160 acres of the better types of land merely by fencing it. Somewhat larger allotments were allowed on poorer types of land. These allotments could be leased or sold to white people. Early agricultural practices were very primitive, and, as a rule, the cultivated area on each farm was small. In clearing operations, the trees were killed by girdling or chopping, and the stumps were left. In cultural operations these stumps were avoided as much as possible, and they still remain on many farms.

Since the early settlement by whites, there has been an increase in the size of farms and an increase in the acreage devoted to cotton, peanuts, and oats, but the acreage in corn has decreased. The trend in the acreage of the principal crops is shown in table 2.

Fruit orchards have declined in importance. In 1920, there were 35,216 bearing peach trees, 3,881 bearing apple trees, and 3,478 bear-

ing plum and prune trees. By 1935 the numbers of these trees had been reduced to 14,200, 1,627, and 2,620, respectively. Pecan growing, however, is becoming more important. The number of pecan trees doubled between 1920 and 1930, when 54,324 bearing trees were reported.

TABLE 2.—*Acreage of the principal crops in Carter County, Okla., in stated years*

Crop	1909	1919	1929	1934
	Acres	*Acres*	*Acres*	*Acres*
Cotton	42, 364	75, 439	23, 240	23, 597
Corn	60, 178	32, 425	37, 040	14, 621
Oats	1, 223	13, 288	6, 876	8, 690
Sorghums for grain	------------	------------	3, 240	5, 105
Wheat	120	6, 442	1, 007	399
Peanuts	58	278	6, 044	1, 320
Tame hay	1, 340	5, 887	9, 195	[1] 16, 332
Wild hay	1, 126	3, 407	6, 373	------------
Sorghums for silage, hay, or fodder	------------	------------	6, 155	7, 351

[1] All hay.

About one-half of the cattle are of dairy breeds, and the rest are of beef breeds. Almost all of the beef cattle are good grade Herefords, and most of them are raised in the vicinities of Arbuckle Mountains and Criner Hills, and in the southwestern part of the county. Dairy cattle, mostly Holstein-Friesians, are more numerous near Ardmore. Jerseys and Guernseys are common.

Hogs are kept on most farms and are particularly numerous on the wooded bottom land. Most of them are good-quality Duroc-Jerseys and Poland Chinas. Chickens are kept on practically all farms. Plymouth Rock, Rhode Island Red, and White Leghorn are the preferred breeds.

The number of livestock on farms, as reported by the census, is given in table 3.

TABLE 3.—*Number of livestock on farms in Carter County, Okla., in stated years*

Livestock	1910	1920	1930	1935
	Number	*Number*	*Number*	*Number*
Horses	7, 173	5, 724	4, 078	3, 957
Mules	3, 692	4, 936	4, 071	3, 847
Cattle	27, 956	21, 471	26, 766	35, 861
Swine	18, 884	11, 530	14, 159	8, 758
Poultry	80, 786	109, 100	[1] 93, 651	[1] 108, 707

[1] Chickens only.

A total of 382,341 acres, or 71.9 percent of the total area of the county, was included in farms in 1935, of which 145,326 acres, or 27.3 percent of the total area, were available for crops. Woodland pasture took up 89,570 acres of the land in farms; other pasture, 132,695 acres; woodland not pastured, 5,524 acres; and other land, 9,226 acres. In that year, the total number of farms was 2,808; their average size was 136.2 acres; and each farm contained an average of 51.7 acres of cropland. The principal crops grown in 1934 occupied 77,415 acres, or not quite 15 percent of the total area of the county.

Most of the labor is performed by the farmer and his family. Additional labor is hired during rush seasons at the rate of about $1 a day. A large part of the cotton is picked by itinerant labor.

According to the Federal census for 1935, 64.6 percent of the farms are operated by tenants, 34.5 percent by owners, and 0.9 percent by managers. Most of the leasing is on a share basis. The customary lease is that known as third-and-fourth, under which the landlord receives one-fourth of the cotton produced and one-third of the other crops. Under this agreement the tenant furnishes all labor, equipment, and seed. Some half-share cropping also is practiced. Under this type of lease the landlord furnishes teams, equipment, and seed and receives one-half of the crop.

The average farm buildings include a three- or four-room frame house, a small barn, and a chicken house. Farm buildings on better types of soil and in the vicinity of oil developments are a little more pretentious, as a rule, because of supplemental income received from oil leases and royalties. Most of the farms are fenced. Automobiles and trucks are in common use on the better farms. In the rougher and more sandy areas, horse-drawn vehicles are more in evidence.

Mechanical equipment on the average farm consists of a moldboard plow, lister, spike-tooth harrow, cotton planter, one-row cultivator or Georgia stock, and wagon. Tractors have not found favor here except on the smooth prairie areas. Work animals are evenly divided between mules and horses, but heavy work animals are not common.

Although it has been demonstrated at a branch station of the Oklahoma Agricultural Experiment Station at Lone Grove, that the less productive upland soils respond well to commercial fertilizers, especially those containing phosphorus and nitrogen, very little fertilizer is used. Perhaps this is because frequent dry periods in late spring and summer prevent an adequate supply of moisture for growing crops and for the utilization of commercial fertilizers. Without proper moisture conditions these fertilizers are not effective and, in some instances, may even prove detrimental to the plants.

No systematic crop rotation is in general practice. The growing of cowpeas and other legumes is known to be valuable for the soil, especially if the vines are plowed under, and some farmers practice this method of soil improvement. The upland soils are inclined to be deficient in organic matter, and plowing under crop residues or any other vegetable matter or adding barnyard manure greatly improves the lighter textured soils for the production of most crops.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called, collectively, the soil profile. Each horizon of the soil, as well as the parent material beneath, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are

noted. The reaction of the soil [2] and its content of lime and salts are determined by simple tests. The drainage, both internal and external, and such external features as the relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as rough stony land, that have no true soil are called (4) miscellaneous land types.

The most important of these groups is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Durant, Hanceville, Conway, and Verdigris are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. The class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Durant fine sandy loam and Durant loam are soil types within the Durant series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping and because of its specific character is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a subgroup of soils within the type which differ from the type in some minor soil characteristic that may, nevertheless have an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, there may be areas which are adapted to the use of machinery and the growth of cultivated crops and others that are not. Even though there may be no important differences in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in the growth of native plants.

[2] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

Carter County does not have as many types of soils as might be expected from the wide range in geological formation occurring within its borders. Folds in the earth's crust have exposed formations ranging in age from Cambrian to Cretaceous.[8] Many of the formations outcrop as rough stony land and do not enter into the formation of soils. The principal soils of the county are developed from noncalcareous sandstones and calcareous or noncalcareous shales of Permian, Cretaceous, and Pennsylvanian age. Upland soils have developed under both forest and prairie types of vegetation. Their surface layers range in texture from medium to light, are for the most part slightly acid, and are not excessively leached.

In the central and northern parts of the county the distribution of soils is determined largely by the type of geologic formation exposed by folding of the earth's crust. The principal fold occurs along the north side of the county and has produced the Arbuckle Mountains. These mountains are largely resistant limestone, with a few narrow valleys of sandstone and shale. Another folded area occurs in the southern part of the county southwest of Ardmore. This has produced the Criner Hills which also are composed largely of limestone. Both the Arbuckle Mountains and the Criner Hills are surrounded by heavy soils developed from shales. From the Criner Hills northeastward is a section of extreme folding, in which many upturned outcrops of sandstone form parallel rocky ridges running in a northwest-southeast direction. These ridges are separated by valleys produced through the weathering of softer shales. Some of the sandstone ridges are very narrow and may be traced for several miles across the county. Most of the soils developed from shales or fine-grained sandstones are Prairie soils, and those developed from sandstone are forested soils.

In other parts of the county the distribution of soils is determined for the most part by topography and drainage, rather than by the geologic formations. An area of light-textured forested soils is in the southern part and extensive areas of Prairie soils are in the southwestern part.

Figure 2 is a generalized map showing the distribution of soils in this county.

On the basis of general suitability of the soils for agricultural use and of their capabilities in production, the soils of related features are arranged (for discussion) in four groups, as follows: (1) Dark Prairie soils, including Durant fine sandy loam, Durant loam, Durant clay loam, Ellis clay, eroded phase, Riverton gravelly loam, Denton clay, Summit clay loam, Kirkland loam, Zaneis very fine sandy loam, Newtonia very fine sandy loam, and Vernon clay; (2)

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[8] TOMLINSON, C. W. OIL AND GAS IN OKLAHOMA. Okla. Geol. Survey Bull. 40, v. 2, pp. 239–310, illus. 1930.

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light-colored upland soils, including Hanceville fine sandy loam, Conway fine sandy loam, and Conway fine sand; (3) soils of the terraces and bottom lands, including Teller very fine sandy loam, Teller fine sandy loam, Verdigris clay, Brewer clay, Verdigris clay loam, Pope fine sandy loam, and Yahola very fine sandy loam; and (4) nonarable soils and land, including rough stony land (Denton soil material), rough stony land (Hanceville soil material), and Hanceville fine sandy loam, eroded phase.

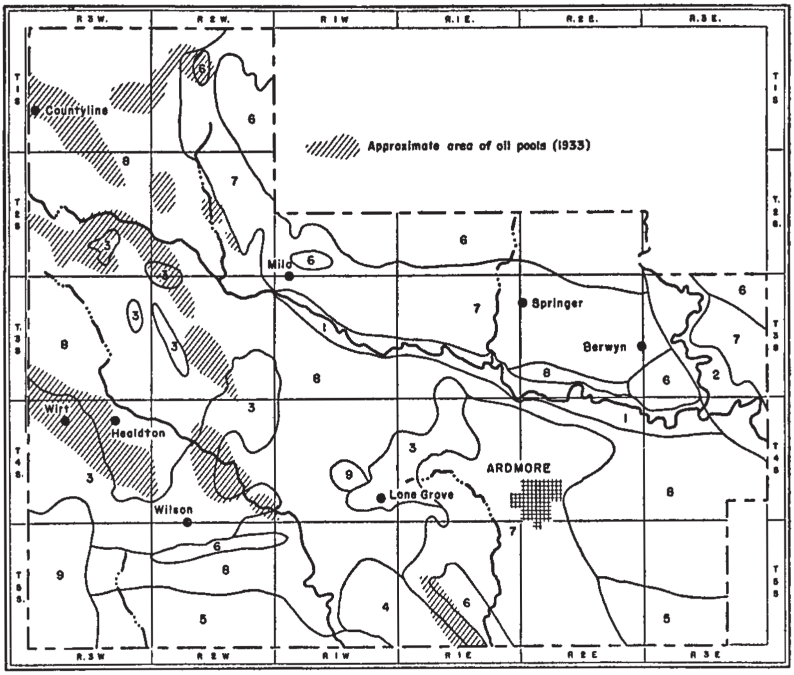


FIGURE 2.—Sketch map indicating the distribution of soil groups in Carter County, Okla.: 1, Alluvial soils subject to overflow; 2, soils of the stream terraces above ordinary overflow (Teller); 3, sandy dark Prairie soils (Durant); 4, sandy light-colored soils on flats and divides (Conway); 5, deep sandy soils (Conway fine sand); 6, rough stony land; 7, heavy dark Prairie soils (Durant, Summit, Denton); 8, sandy light-colored soils with red subsoils (Hanceville); 9, heavy dark Prairie soils with red subsoils (Vernon, Kirkland).

The soils of this county have only moderate capabilities for use, their range of crop adaptations is not wide, and their inherent productivity is not great. Cotton and corn are the principal crops. In general little relationship exists between the type of soil and the crop grown on it.

Cotton, the chief cash crop, is grown on practically all farms, regardless of the special suitability of the soil. A large proportion of the better smooth soils are devoted to cotton. This crop is grown most successfully on the smooth bottom-land and terrace soils. The best yields are obtained on the Teller and Verdigris soils, although on the latter soil the crop sometimes is injured by overflow. Cotton also does well on the deeply developed Prairie soils, but it produces only low yields on the upland sandy soils, such as Hanceville fine sandy loam and the Conway soils. Fair yields may be obtained on

these light-colored sandy soils, however, if maintenance of natural soil fertility is practiced.

Corn and oats are grown to a somewhat greater extent on the smooth deep Prairie and bottom-land soils, and the best yields of corn are produced on the latter soils. Alfalfa, although grown on small areas, does well on the better drained alluvial soils, such as Verdigris clay loam, Verdigris clay, and Yahola very fine sandy loam. The smooth Prairie soils, such as those of the Durant series, are preferred for the production of small grains.

Fruits are grown successfully in the many home orchards on most of the soils, but peaches, plums, grapes, and berries, as well as vegetables and truck crops, do best on friable sandy soils with moderately heavy subsoils, such as the members of the Teller, Hanceville, and Conway series. The commercial production of fruits, vegetables, and truck crops, however, is not great.

Large areas of nonarable soils occur in various parts of the county, and they are used only for pasture and forestry. Rough stony land (Hanceville soil material) supports a growth mainly of small oak trees, and the sandy soil material is not especially well suited to the more highly nutritious native grasses. Pasturage on this land, therefore, is unimportant. Rough stony land (Denton soil material) is composed mainly of limestone, and the fine earth supports a good growth of highly nutritious grasses which are utilized largely for the production of beef cattle under range or ranching conditions. Beef cattle, mainly of the Hereford breed, are raised and grazed mostly on the nonarable stony soils of the Arbuckle Mountains and Criner Hills, also on some of the Prairie land, such as Zaneis very fine sandy loam, Kirkland loam, and Vernon clay, in the southwestern part of the county. A supplemental ration of cottonseed meal and cake, coarse forage, oat straw, and other roughage is fed. The cattle are fattened and butchered locally or are shipped to packing houses at Oklahoma City and Fort Worth. Some beef cattle are raised and fed on farms.

In the following pages of this report the soils of Carter County are described in detail, and their agricultural relationships are discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Carter County, Okla.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Durant fine sandy loam	46,848	8.8	Teller fine sandy loam	1,024	0.2
Durant loam	23,232	4.4	Verdigris clay	19,136	3.6
Durant clay loam	20,224	3.8	Brewer clay	1,792	.3
Ellis clay, eroded phase	27,520	5.2	Verdigris clay loam	37,824	7.1
Riverton gravelly loam	4,800	.9	Pope fine sandy loam	9,536	1.8
Denton clay	5,056	1.0	Yahola very fine sandy loam	6,272	1.2
Summit clay loam	10,496	2.0	Rough stony land (Denton soil material)	27,392	5.1
Kirkland loam	2,304	.4			
Zaneis very fine sandy loam	6,784	1.3	Rough stony land (Hanceville soil material)	29,760	5.6
Newtonia very fine sandy loam	768	.1			
Vernon clay	17,472	3.3	Hanceville fine sandy loam, eroded phase	18,560	3.5
Hanceville fine sandy loam	125,504	23.6			
Conway fine sandy loam	59,328	11.1			
Conway fine sand	22,464	4.2	Total	531,840	
Teller very fine sandy loam	7,744	1.5			

DARK PRAIRIE SOILS

The normal dark Prairie soils are characterized by a smooth relief and dark-brown or dark grayish-brown topsoils, from 14 to 18 inches thick, underlain by slightly heavier subsoils. They have a comparatively high content of organic matter and contain moderate quantities of plant nutrients. These soils are developed from shales or fine-grained sandstones and limestones. They occur in a wide belt south of the Arbuckle Mountains, in the vicinity of Ardmore, and in the southwestern part of the county, particularly in the vicinity of Wilson. Together they comprise almost one-third of the area of the county. These soils are comparatively productive and are suited to the production of the principal crops grown in this section. On the steeper slopes associated with the smooth areas of Prairie soils are areas in which the soils are somewhat lighter colored than those in the smooth areas, although they are darker than the forested soils. The parent material is either red or brown in the steeper areas. The steepness of the slopes in these areas of somewhat lighter colored soils makes cultivation impractical. The dark Prairie soils are members of the Durant, Ellis, Riverton, Denton, Summit, Kirkland, Zaneis, Newtonia, and Vernon series.

Durant fine sandy loam.—The 12- to 16-inch topsoil of Durant fine sandy loam consists of dark grayish-brown or very dark grayish-brown slightly acid fine sandy loam, and it contains some fine concretions of ferruginous sandstone. The material, when thoroughly dry and exposed, separates into large irregular columns which in places break horizontally and form large blocks. It is underlain by yellowish-brown clay loam, faintly mottled with gray, containing numerous fine black pellets of sandstone. At a depth of about 20 inches, this material passes into yellowish-brown crumbly clay, somewhat mottled with gray and red. At a depth ranging from 4 to 5 feet, this material, in turn, passes into weathered sandstone which contains large fragments of unweathered sandstone and rests on solid sandstone at a depth ranging from 4 to 8 feet.

This soil occurs in smooth gently rolling large unbroken areas. The virgin soil supports a heavy growth of grass consisting largely of blue grama, buffalo grass, side-oats grama, and bluestem. The land is very productive when first put in cultivation, but unless careful cultural practices are followed, crop yields decrease and rapid deterioration from erosion takes place. Approximately 40 percent of this soil is used for the production of cotton, 35 percent for corn, 10 percent for oats, and 15 percent for native pasture. Yields of cotton range from 100 to 250 pounds to the acre, corn 10 to 30 bushels, and oats 20 to 50 bushels (pl. 1, *A*).

Bodies of this soil occur in all parts of the county. The largest are in the vicinities of Wilson, McMan, Deese, and Wheeler. This is the most extensive soil of the group.

Durant loam.—Durant loam differs from Durant fine sandy loam principally in texture. The 14-inch topsoil is very dark grayish-brown loam which breaks naturally into large blocks or columns when dry. It grades into brown or yellowish-brown and red mottled clay loam, and this, in turn, grades into heavy but less dense yellowish-brown clay below a depth of 24 inches. Weathered fine-grained

partly disintegrated sandstone or sandy shale is present at a depth ranging from 6 to 8 feet.

This soil is better adapted to the production of corn and oats than is Durant fine sandy loam because of its heavier texture and somewhat higher fertility. It is one of the most productive upland soils in the county. It is distinctly a Prairie soil and occurs on smooth or gently rolling divides. The native vegetation consists mainly of a heavy sod of buffalo and grama grasses. The crops commonly grown are corn and cotton, and some oats are produced. Yields of corn range from 10 to 30 bushels an acre, cotton 100 to 250 pounds of lint, and oats 25 to 60 bushels.

The principal areas of Durant loam are in the vicinities of Ardmore, Berwyn, Springer, Young School, Prairie, and Pooleville.

Durant clay loam.—The profile of Durant clay loam is similar in general features to Durant loam. It is developed from noncalcareous or faintly calcareous shales and sandstone material, and the topsoil is heavier in texture than that of Durant loam. This soil is called locally "black land," but it differs from the black lands of Texas and of Marshall and Bryan Counties, Okla. The relief ranges from smoothly undulating to rolling (pl. 1, *B*).

The 10- to 15-inch topsoil consists of very dark grayish-brown or dark-brown clay loam which is very friable and easily worked under ordinary moisture conditions. It grades into yellowish-brown or rusty-brown clay that is plastic when wet. At a depth ranging from 24 to 36 inches, this material, in turn, passes into dark-gray or drab clay loam containing a few rusty-brown mottlings. In places the subsoil has a very heavy claypanlike character owing to a saline condition, locally called "alkali." The subsoil rests on a bed of weathered noncalcareous or only slightly calcareous shales, largely of Pennsylvanian age.

This soil packs hard and shrinks in places, leaving many cracks during droughty periods in summer. Moisture conditions are sometimes unfavorable for the growth of crops. The land is used chiefly for the production of corn, cotton, and oats. Yields of corn range from 8 to 25 bushels an acre, cotton from 120 to 250 pounds of lint, and oats from 25 to 50 bushels. Crop yields are slightly higher than on Durant fine sandy loam if moisture is adequate. This soil is not especially suited to the production of fruit, watermelons, peanuts, or truck crops.

The heavy texture of this soil causes slow absorption of rain water, and on unprotected slopes run-off is rapid and erosion severe. Terracing, strip cropping, or other measures of protection should be practiced, in order to preserve the soil.

The principal areas of this soil are in the vicinities of Ardmore, Glenn School, Springer, Young School, Lone Grove, and Brock.

Ellis clay, eroded phase.—Ellis clay, eroded phase, is merely the slightly weathered shaly material occurring on slopes so steep and eroded that a deep surfaace soil has not been developed. The topmost 6 inches is brown or yellowish-brown noncalcareous or faintly calcareous clay loam. It contains a few sandstone and chert fragments. In a few smooth places a dark-brown clay topsoil has been developed. Below the thin surface layer is yellowish-brown or

grayish-brown clay which grades into partly weathered shale. The clay subsoil is slick, owing to the presence of shale particles.

This soil occurs principally in the prairie sections of the county, in the east-central part, near Ardmore, Springer, Woodford, and Young School, in association with Durant clay loam. The land is rapidly drained and is severely eroded in many places. Many slopes are deeply gullied.

This soil supports a growth of coarse prairie grasses and is utilized only for pasture. In most places the land is too steep for satisfactory cultivation.

Riverton gravelly loam.—Riverton gravelly loam is a dark-brown gravelly soil made up of dark fine earth, chiefly of clay loam texture, in which a large quantity of rounded chert, limestone, and sandstone gravel is present. The 6- to 12-inch topsoil grades into brown or yellow gravelly clay, and this rests, at a depth ranging from 2 to 4 feet, on yellow calcareous gravelly clay. The soil has been developed from the fine-earth and gravelly outwash from the Arbuckle Mountains, deposited along the plain adjacent to the mountains. The material is not calcareous in the upper layers, but evidently it is largely a product of disintegrated limestone.

Most of this soil is utilized for pasture, as the large content of gravelly material in places makes it unsuited for farm crops. A few small areas are cultivated, and yields are considerably less than those obtained on Summit clay loam. Cotton produces about 80 pounds an acre, corn 10 bushels, and oats 12 bushels.

This is an inextensive soil. The principal areas occur in long, narrow valleys in the Arbuckle Mountains and along the southern border of these mountains north of Springer and near Woodford.

Denton clay.—Denton clay has a 10-inch topsoil of brown or dark-brown crumbly clay. This grades into grayish-brown or brown heavy crumbly clay containing a few small chert or limestone fragments. The subsoil rests on unweathered limestone at a depth ranging from 18 to 60 inches. Small patches of limestone outcrop in a few places.

Most of the land is in pasture, as it supports an excellent growth of buffalo, grama, and bluestem grasses. Small areas have been devoted to oats and more rarely to cotton. Local reports indicate that yields are uncertain, owing to the rather steeply sloping relief, which favors rapid run-off of rain water and erosion where the slopes are unprotected by vegetation. In places where the soil is deeper, cotton yields about 140 pounds an acre, corn 20 bushels, and oats about 36 bushels.

The largest areas of this soil are in the vicinity of the Arbuckle Mountains, north and south of Pooleville.

Summit clay loam.—Summit clay loam is somewhat similar to the closely associated Durant clay loam. It has, however, a more highly granular and, for the most part, a darker topsoil and a less yellow subsoil than Durant clay loam. The 10-inch topsoil is black granular clay loam, and, when dry, the material in cultivated fields has a loamlike texture. This material grades into brown or dark-gray heavy crumbly clay. Limestone lies at a great depth below the surface. In places the exact parent materials of the soil are difficult to determine. In some places the soil is developed from outwashed dark

soil materials deposited in deep beds at the lower edges of the slopes and valleys of the Arbuckle Mountains.

The relief ranges from undulating to flat, and drainage is adequate. The land is used chiefly for the production of corn, cotton, and oats. Yields and crop adaptations seem to be about the same as for Durant clay loam, but Summit clay loam is probably better suited than the Durant soil for the production of corn and alfalfa. Average acre yields of corn are about 25 bushels; of cotton, 160 pounds; and of oats, 43 bushels.

An almost continuous belt of this soil extends from Woodford eastward to a point north of Berwyn. Some areas are farther north and west, near Roundup, Pooleville, and the Murray County line, in the extreme northern part of the county.

Kirkland loam.—Kirkland loam so closely resembles Durant loam in the surface soil that it is difficult to distinguish between the two soils in places, but it differs from the Durant soil in that it has a dense heavy subsoil. The topsoil of Kirkland loam is brown or dark grayish-brown silty loam ranging from 6 to 15 inches in thickness. It is friable when moist but has a tendency to bake into a hard tight mass when dry. The topsoil gives way abruptly to a very dark brown, dark grayish-brown, or, in places, reddish-brown tough compact claypan which continues to a depth of about 40 inches. Below this depth the material is chocolate-brown or gray heavy clay containing reddish-brown spots and some fragments of unweathered shale. At a depth of about 60 inches a red clay is reached, which overlies the Permian shale. Although this shale is calcareous, the surface soil and subsoil are not calcareous.

Crop yields and methods of land utilization are similar to those on Durant loam. Average acre yields of corn are 10 bushels; of cotton, 140 pounds; and of oats, 35 bushels. This soil covers only a very small total area in the extreme southwestern part of the county, but it is more extensive in adjoining counties on the west.

Zaneis very fine sandy loam.—Zaneis very fine sandy loam is a Prairie soil developed from about the same formations as the Kirkland and Vernon soils. The topsoil, to a depth of about 4 inches, is dark-brown loose friable very fine sandy loam having a neutral or slightly acid reaction. This material grades into dark chocolate-brown or reddish-brown fine sandy loam or very fine sandy loam. Below a depth ranging from 8 to 18 inches is red or brownish-red clay which, when dry, breaks into irregular shiny-surfaced clods. This layer is not a claypan. The material grades into red clay which overlies the red shale of Red Beds material. In places the parent material is slightly calcareous.

The relief is rolling and moderately sloping, and, in places, the land is eroded and the soil layers are shallow. As the soil erodes severely under cultivation, its best use is for pasture. When protected by terraces and carefully cultivated, it returns fair yields of crops. Corn yields an average of about 10 bushels an acre, cotton 80 pounds, and oats 27 bushels. Small bodies of this soil are associated with Kirkland loam and Vernon clay in the southwestern part of the county.

Newtonia very fine sandy loam.—Newtonia very fine sandy loam, a reddish-brown Prairie soil, is similar to Zaneis very fine sandy

loam, but it is derived from limestone instead of shale. The topsoil is chocolate-brown or reddish-brown very fine sandy loam, to a depth ranging from 6 to 10 inches. This material grades into reddish-brown or dark-red clay loam which, below a depth of 12 or 15 inches, passes into red or yellowish-red clay containing fragments of chert in places. Below a depth of about 3 feet, partly weathered limestone is reached, and this, at a depth ranging from 4 to 8 feet, rests on solid limestone.

The relief is undulating, the slopes moderate, and drainage rapid. Fair crops are obtained in places where the land is carefully cultivated. This soil is subject to severe erosion, and, in places, badly washed fields return low yields. The land is used chiefly for pasture and for the production of cotton, oats, and small grains. Average acre yields of corn are about 10 bushels; of cotton, 80 pounds; and of oats 26 bushels.

This soil occurs only in small bodies northeast of Pooleville.

Vernon clay.—Vernon clay is a shallow slightly developed red calcareous soil developed from the Permian Red Beds. The 6-inch topsoil is red or brownish-red clay which is noncalcareous or only slightly calcareous in places. The thin topsoil grades into brownish-red or red clay which is plastic when wet and is calcareous in places. The material in both layers breaks into hard irregular clods when dry. Below a depth of several feet are the red calcareous heavy shales of the Permian Red Beds with some thin interbedded sandstone strata in places. Thin beds of limestone also occur in this material.

Vernon clay occupies steep slopes near drainageways, principally in the southwestern part of the county. It supports a good growth of blue grama, buffalo, and other native prairie grasses in most places and is utilized only for pasture. The soil is too thin, sloping, and droughty for successful cultivation.

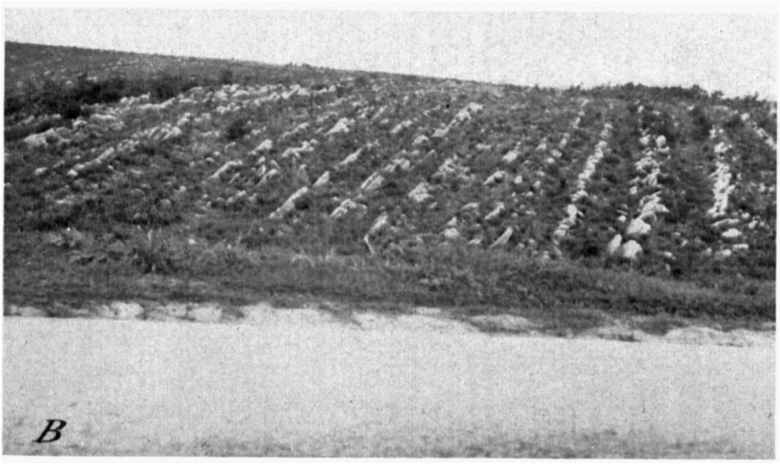
LIGHT-COLORED UPLAND SOILS

The light-colored upland soils have thin grayish-brown surface layers underlain by light-textured light-colored subsurface material which, in turn, is underlain by markedly heavier yellowish-brown or reddish-brown subsoils. These soils are more strongly leached than the normally developed Prairie soils and are, therefore, much lower in inherent fertility. On the other hand, they respond more readily to the addition of fertilizers and to improved cultural practices. They are especially adapted to the production of cotton, vegetables, fruits, and berries. Peanuts also do well. Corn and oats are grown, but yields are low. Although the light-colored upland soils comprise only three soil types—Hanceville fine sandy loam, Conway fine sandy loam, and Conway fine sand—they cover more than one-third of the total area of the county.

Hanceville fine sandy loam.—Hanceville fine sandy loam is the most extensive soil in the county, and it occurs in all parts except in the prairie and Arbuckle Mountain sections.

The topsoil, to a depth ranging from 4 to 8 inches, is brown or grayish-brown fine sandy loam. In virgin areas this layer is covered with a thin layer of fine sandy loam darkened by a slight accumula-

A, Field of oats on Durant fine sandy loam, showing terraces constructed to conserve soil and moisture; *B*, native prairie on Durant clay loam.



A, Hanceville fine sandy loam, showing recently cultivated land in the foreground and young trees encroaching on formerly cultivated land in the background; *B*, rough stony land (Denton soil material) on crest of Arbuckle Mountains with outcrops of uptilted limestone strata.

tion of leafmold. The topsoil grades into friable yellowish-red fine sandy clay or sandy clay, in which, at a depth of about 16 inches, a few yellow or reddish-yellow mottlings appear. At a depth ranging from about 3 to 5 feet below the surface, the color changes to gray mottled with brown, yellowish brown, or yellowish red. This layer is weathered partly disintegrated sandstone and contains unweathered sandstone fragments. Consolidated sandstone underlies the soil at a depth ranging from 3 to 8 feet.

This soil is too shallow and too excessively drained to be inherently highly productive. It occurs on both gentle and steep slopes and is generally rolling (pl. 2, *A*). Extensive areas formerly cultivated have been ruined by erosion. Under good management the soil can be made to produce very satisfactory crops of cotton, peanuts, cowpeas, and watermelons. It is well suited to the production of fruits, berries, grapes, and vegetables. Yields vary widely because the soil is so responsive to different cultural methods. Cotton yields from 55 to 150 pounds of lint an acre, corn 10 to 25 bushels, and oats 15 to 35 bushels. This soil is not very well suited to corn or oats because of its light texture, low content of organic matter, and deficiency in some plant nutrients. About one-half of the land is still in forest, and the rest is cultivated principally to cotton, although extensive areas are devoted to corn and oats. The native vegetation consists largely of post and blackjack oaks, together with a few hickory and other trees and shrubs and some buckbrush. Coarse bunch grass grows in places where the forest growth is not dense.

Conway fine sandy loam.—Conway fine sandy loam, the second most extensive soil in the county, occupies smooth divides associated with Hanceville fine sandy loam throughout the northwestern, west-central, and southern parts. It is much deeper and, under most conditions, more productive than the Hanceville soil. In cultivated fields the 12- to 15-inch topsoil is grayish-brown or yellowish-brown loose fine sandy loam. A 1- to 5-inch layer darkened by leafmold overlies the virgin soil. The subsoil is yellow friable fine sandy clay which continues to a depth of about 30 inches. The thick subsoil is of value as a reservoir in holding moisture. Below this layer is a yellow, gray, and red mottled fine sandy clay or clay loam, which is largely a mass of disintegrated partly weathered sandstone. Sandstone bedrock is reached at a depth of many feet below the surface.

Conway fine sandy loam has a smoothly rolling or almost flat relief. Terracing has proved advantageous in preventing erosion on this soil as well as on Hanceville fine sandy loam. The Conway soil has developed under a forest cover and does not have a large store of organic matter. It responds readily to improved agricultural practices, and about 80 percent of the land is in cultivation. It is suited to a number of the principal crops grown in this section, and moderate yields are obtained when crops receive good care. Yields of cotton range from 75 to 200 pounds and average 100 pounds of lint cotton to the acre. Corn yields from 15 to 40 bushels, oats 20 to 50 bushels, and peanuts 15 to 25 bushels. Peaches, plums, cherries, berries, grapes, and vegetables do well.

The native vegetation consists largely of post and blackjack oaks, various shrubs, and some coarse bunch grass beneath the trees.

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Small areas of dark Prairie soils are associated with this soil. Surface drainage in places is restricted, and the land cannot be cultivated so soon after rains as can other sandy soils, although, as a rule, underdrainage is good.

Conway fine sand.—Conway fine sand is looser and lighter in texture and, therefore, has a greater tendency to blow than Conway fine sandy loam. The 4-inch surface soil is brown loamy loose friable fine sand. Below this, yellowish-brown or grayish-brown fine sand continues to a great depth without change. In some places this sand rests on yellow or red fine sandy loam at a depth ranging from 2½ to 8 feet. The soil has developed from sandy beds which probably consisted originally of sandstone materials.

Large areas of this soil lie along the southern boundary of the county south of Wilson and in the southeastern part. This soil is not so extensive as the other two members of the group. Blackjack oak, together with some post oak and coarse grasses, largely bluestem, constitutes the native vegetation. The soil is better suited to the growing of some trees than to the production of most crops, as it is not only deficient in certain essential plant nutrients but is also subject to blowing. Run-off of rain water is not rapid, but the surface soil is so loose that it washes readily where unprotected.

Approximately 30 percent of the land is cultivated, chiefly to cotton, cowpeas, peanuts, and watermelons. Yields in general are considerably less than those obtained on Hanceville fine sandy loam. Oats and corn return poor yields. Yields of cotton range from 70 to 125 pounds of lint an acre. Corn yields about 10 bushels and oats about 25 bushels. Some fruits, berries, grapes, vegetables, and truck crops are grown successfully.

SOILS OF THE TERRACES AND BOTTOM LANDS

The soils of the terraces are above overflow and are, on the whole, the most productive soils in the county. The soils of the bottom lands vary in color and texture, depending on the source of the soil materials. They are inherently highly productive, but crop production is uncertain because of slow drainage in places and occasional losses due to overflow. The soils of this group have developed under a forest cover, mainly oaks, although most of the land is now cleared. Included in this group are members of the Teller, Verdigris, Brewer, Pope, and Yahola series. They comprise about 15 percent of the total area of the county.

Teller very fine sandy loam.—Teller very fine sandy loam occupies terraces or high second bottoms, mainly in the Washita River Valley. A few small bodies occur along Caddo Creek and its tributaries. This is one of the most productive soils in the county because of its favorable situation and certainty of crop production, and practically all of it is in cultivation.

The topsoil, to a depth of about 8 inches, is dark chocolate-brown friable very fine sandy loam. This grades into reddish-brown or red very fine sandy loam or fine sandy clay loam, which becomes slightly heavier with depth.

The soil lies well above the present level of overflow. It is developed from old alluvium deposited when the river flowed at a

higher level. As a rule, all the crops commonly grown in this section return very good yields. Local reports indicate that the soil responds well to improved methods of cultivation and crop rotation. Pecan trees do well, and some commercial orchards have been started. Alfalfa is generally a successful crop. Yields of corn average about 25 bushels to the acre and range from 20 to 45 bushels. Cotton yields 150 to 350 pounds of lint an acre, and oats 30 to 60 bushels. Fruits and vegetables produce good yields.

The relief is smooth. Surface drainage is good, and the friable subsoil allows good underdrainage. The subsoil contains sufficient clay to hold a large reserve of soil moisture.

Teller fine sandy loam.—Teller fine sandy loam is similar to Teller very fine sandy loam, but it is slightly lighter colored, somewhat coarser textured, and looser than that soil. Although suited to the same crops, yields on the fine sandy loam are considerably lower because of its lower inherent fertility and lighter textured topsoil and subsoil. The Teller soil resembles Conway fine sandy loam in some features, but the lower subsoil layer is less yellow. The topsoil is grayish-brown loose fine sandy loam ranging from 12 to 16 inches in thickness. This material grades into red fine sandy clay loam or, in places, yellowish-brown fine sandy loam or sandy clay.

This soil is developed on smooth nearly flat high benches in association with Teller very fine sandy loam, but its total area is much smaller than that of the associated soil. The native vegetation appears to have been largely oak trees. The unprotected soil is subject to blowing in the spring. Cotton yields an average of about 125 pounds of lint to the acre, corn 15 bushels, and oats 27 bushels.

Verdigris clay.—Verdigris clay is a dark soil composed of alluvial materials. It occurs along streams which originate in the section of the dark Prairie soils. The topsoil is very dark grayish-brown or nearly black granular clay loam which is very plastic and sticky when wet. At a depth of 12 or 15 inches, it grades into dark-brown or dark-gray clay. This layer is somewhat lighter in color than the one above and contains a few darker streaks of material washed down into cracks during rains following droughts. Below a depth of about 40 inches, is a brown or grayish-brown noncalcareous clay which is plastic when wet. None of the soil layers is calcareous.

Yields on this soil are uncertain because of occasional losses due to overflow. The soil dries deeply and cracks during periods of drought in late summer. Cotton, corn, alfalfa, and oats are grown, and excellent yields of these crops are obtained in many years. Cotton yields from 100 to 300 pounds of lint to the acre, corn from 10 to 25 bushels, and oats about 45 bushels. Native pecan groves are common on this land, and commercial plantings do well except in poorly drained areas.

The principal areas of this soil are on the flood plain of Caddo Creek and its tributaries east of Milo. It covers a rather large total area.

Brewer clay.—Brewer clay is developed on the Washita River terraces near the mouths of smaller streams originating in the section of heavier Prairie soils. It is composed largely of alluvial-fan material deposited by these streams. The topsoil is very dark gray or

black clay which is friable when moist. At a depth of about 12 inches, this grades into dark-brown heavy plastic clay.

The relief is flat, and drainage is slow. Yields are more certain on this soil than on Verdigris clay, and, therefore, average yields are greater. Cotton yields about 150 pounds to the acre, corn 16 bushels, and oats 30 bushels. The same crops are grown on this soil as on Verdigris clay. Practically all of the land is in cultivation.

Verdigris clay loam.—Verdigris clay loam occupies the bottom lands along streams, most of which drain the forested areas, although in some places Prairie soils also have contributed sediments. The topsoil is brown or grayish-brown noncalcareous and comparatively friable clay loam ranging from 12 to 16 inches in thickness. As a rule, the color fades with depth, and below a depth of 24 inches the material is yellow and gray mottled clay or clay loam. In places layers of darker material are present in the surface soil or subsoil. These layers probably represent sediments washed from the dark Prairie soils.

The greater part of this soil is in native pasture, as cultivation is uncertain, owing to the danger of overflow. The native vegetation consists of a heavy growth of elm, black, red, and blackjack oaks, pecan, hickory, and elder. Many hogs are raised on this land. They feed on acorns, pecans, and hickory nuts. Pecans do well on all except the poorly drained areas.

Some corn and cotton are grown. Yields are extremely variable but are good when the crops are not damaged by overflow. Results are generally more certain with corn. Overflows are more common along the smaller creeks. Cotton yields about 145 pounds of lint to the acre, corn about 20 bushels, and oats 25 bushels. Johnson grass and other weeds are very troublesome.

Long narrow strips of this soil border most of the larger streams, except Washita River and the lower part of Caddo Creek. This is one of the more extensive soils of the county.

Pope fine sandy loam.—Pope fine sandy loam is grayish-brown or brown loose friable but not calcareous fine sandy loam to a depth of about 14 inches. The material in the upper part of the subsoil varies considerably, but, in most places, it consists of brown or dark grayish-brown light-textured stratified sediments. The lower part of the subsoil in most places is grayish-brown noncalcareous fine sandy loam. This soil comprises alluvial materials washed chiefly from forested sandy soils of the Hanceville and Conway series.

Strips of this soil occur on the bottoms near the sources of the smaller streams draining the sandier sections of the county. The land is subject to overflow, and crop production is uncertain. Some cotton and corn are grown, of which the average yields are 110 pounds and 20 bushels an acre, respectively. Pecan trees do well. Yields of the farm crops grown are good when overflows are not excessive. The greater part of this land is utilized as native pasture. The soil supports about the same forest growth as does Verdigris clay loam.

Yahola very fine sandy loam.—Yahola very fine sandy loam consists of alluvial materials deposited on the flood plains of Washita River and some of the smaller streams in the southwestern part of the county, originating in areas developed from the Red Beds. The

topsoil is red or reddish-brown very fine sandy loam to a depth of about 12 inches. This is underlain by red very fine sandy loam or loamy very fine sand. The subsoil is variable and, in places, contains layers of silty material, but, below a depth ranging from 3 to 4 feet, the material is very light and sandy. The surface soil and subsoil are generally calcareous. Included are small areas which would have been mapped as Miller very fine sandy loam had they not been too small to show on a map of the scale used. The included soil differs from Yahola very fine sandy loam in that it has a heavy subsoil.

Areas of this soil are low lying and are subject to frequent overflow. Most of the soil is used as Johnson grass pasture, but a few patches are cultivated. Good yields are obtained when the overflows cause no damage. Average yields of corn are about 20 bushels an acre, cotton 80 pounds, and oats 20 bushels.

NONARABLE SOILS AND LAND

Nonarable soils and land are rough broken or stony land that is not suited to the production of cultivated crops. The vegetation includes both forest and prairie types. These soils are utilized only as pasture land. The principal areas are in the Arbuckle Mountains, in the Criner Hills, and southwest of Berwyn. The members comprising the group are rough stony land (Denton soil material), rough stony land (Hanceville soil material), and Hanceville fine sandy loam, eroded phase. These miscellaneous land types and soil divisions have developed little or no soil in most places, and the underlying stony material lies near the surface or outcrops. The total area of this rough land is slightly less than 15 percent of the county.

Rough stony land (Denton soil material).—Rough stony land (Denton soil material) consists largely of treeless limestone hills which support a fair growth of excellent grasses in cracks and depressions where a thin layer of brown clay loam soil material has accumulated over the solid limestone and between the rock materials. This land is suited only for pasture and is used largely for livestock range. The principal areas are in the Arbuckle Mountains (pl. 2, *B*) along the northern part of the county and in the Criner Hills southwest of Ardmore.

Rough stony land (Hanceville soil material).—Rough stony land (Hanceville soil material) consists of sandstone or conglomerate outcrops and escarpments. Most of this land supports a growth of oak trees and a scant growth of grass, which in places is used for pasture. This land differs from rough stony land (Denton soil material) in that the fine earth is sandy and does not support so much or so good a quality of grass. Some of this land lies in the Arbuckle Mountains and Criner Hills. Other areas occur as bluffs along Caddo Creek and Demijohn Creek Valleys.

Hanceville fine sandy loam, eroded phase.—Hanceville fine sandy loam, eroded phase, is a nonagricultural soil occurring in places where severe erosion has prevented the development of a normal soil. It consists largely of gray and yellow weathered sandstone intermingled with shallow sandy layers. There are some outcrops of consolidated sandstone. The profile is variable. The surface soil in most places is yellowish-brown or gray fine sandy loam. It resembles the sub-

stratum below Hanceville fine sandy loam and differs from rough stony land (Hanceville soil material) in that it is much less stony. This soil supports a growth of post and blackjack oaks. It is utilized only as pasture. The grasses are thin and not highly nutritious. Small areas of this soil occupy the rougher parts of the sandstone sections of the county, in association with Hanceville fine sandy loam and Conway fine sandy loam.

PRODUCTIVITY RATINGS

The soils of Carter County are rated in table 5 according to their ability to produce the more important crops grown in southern Oklahoma and are listed in the order of their relative general productivity.

TABLE 5.—*Productivity rating of soils in Carter County, Okla.*

Soil [1]	Crop productivity index [2] for—							Principal crop or use of land
	Corn	Oats	Sorghums (forage)	Alfalfa	Cotton	Wild hay	Pasture	
Teller very fine sandy loam	50	100	75	65	45	90	50	Corn, cotton.
Summit clay loam	45	85	75	60	40	90	70	Corn, cotton, alfalfa.
Brewer clay	40	80	70	60	40	75	55	Corn, cotton, oats.
Verdigris clay	40	90	75	60	35	80	60	Do.
Durant loam	40	75	60	45	35	80	60	Do.
Denton clay [3]	40	75	60	45	35	80	60	Corn, cotton, pasture.
Durant clay loam	35	70	60	45	35	80	55	Corn, cotton.
Verdigris clay loam	40	50	55	65	35	50	40	Corn, oats, forest.
Teller fine sandy loam	35	55	50	20	30	------	30	Corn, cotton, forest.
Kirkland loam	20	70	45	15	35	75	55	Corn, cotton, oats, pasture.
Durant fine sandy loam	30	50	50	35	30	75	55	Corn, cotton, oats.
Pope fine sandy loam	40	50	50	50	25	40	35	Corn, forest.
Zaneis very fine sandy loam	25	55	40	20	20	80	60	Cotton, oats, pasture.
Newtonia very fine sandy loam.	25	55	40	20	20	80	60	Do.
Yahola very fine sandy loam	35	40	50	50	20	50	35	Johnson grass, alfalfa.
Conway fine sandy loam	20	50	40	------	25	------	15	Cotton, corn, sorghums.
Hanceville fine sandy loam	20	30	25	------	20	------	10	Forest, cotton, sorghums.
Riverton gravelly loam	20	20	25	------	20	60	45	Pasture, oats, cotton.
Conway fine sand	10	15	20	------	15	------	5	Forest, cotton, peanuts.
Vernon clay	------	------	------	------	------	40	60	Pasture.
Ellis clay, eroded phase	------	------	------	------	------	50	45	Do.
Rough stony land, Denton soil material.	------	------	------	------	------	------	40	Do.
Hanceville fine sandy loam, eroded phase.	------	------	------	------	------	------	10	Forest.
Rough stony land, Hanceville soil material.	------	------	------	------	------	------	10	Do.

[1] Soils are listed in the approximate order of their general productivity in the county, the most productive first.

[2] Soil types inherently most productive for the specified crop in the United States are given the index 100. The soils in Carter County are given indexes which give the approximate production in percent of the standard.

[3] Ratings refer to the deeper portions of this soil.

This rating compares the productivity of each of the soil types, phases, and miscellaneous land classes in the county for each crop to a standard—100. This standard represents the inherent productivity of the most productive soil type, or types, in the United States for that crop. A soil estimated to be one-half as productive for a given crop as the type with the standard rating is given a rating of 50. In a few instances unusually productive soils of limited acreage are given a rating above 100 for a specified crop. Inherent productiv-

ity is conceived to be that level of productivity at or near that existing when the virgin condition became adjusted to tillage practices.

The productivity indexes in table 5 are based on the yields obtained under current farming practices without irrigation, drainage, terracing, and the use of commercial fertilizers, or protection from overflow. As a result, no attempt has been made to give additional ratings for the inherent productivity of the soil. The productivity of most of the soils in the county could be increased by the use of one or more of the above practices.

Economic considerations have played no part in determining the productivity indexes, so they cannot be interpreted directly into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

The following tabulation gives the more important crops of the county and the acre yield that has been set up as a standard of 100 for each crop. These yields represent long-time production averages of the inherently most productive soils of significant acreage in the United States for products of satisfactory quality and are obtained without the use of soil amendments other than the manure produced on the land.

Crop:		
Corn (grain)	bushels	50
Oats	do	50
Sorghums for forage	tons	4
Alfalfa	do	4½
Wild hay	do	1
Cotton	pounds	400
Pasture	cow-acre-days [4]	100

[4] "Cow-acre-days" is a term used to express the carrying capacity of pasture land. It is the numerical equivalent of the number of animal units supported by 1 acre during a given period of days. In Oklahoma the grazing season is long, the livestock running on pasture the entire year, though they are greatly benefited by supplementary feed at times when the pasture is not growing.

RECOMMENDATIONS FOR THE MANAGEMENT OF CARTER COUNTY SOILS [5]

The soils in Carter County have been cultivated less than 50 years. Natural productivity has declined because cropping systems and fertilizers have not been used to replace plant nutrients which have been carried away by erosion or removed in crops. Such a condition must be corrected in order to develop a type of agriculture that will improve the soil and maintain a higher standard of living in rural communities.

Cotton can be grown successfully on soils which will not produce good yields of wheat and corn. Since clean-cultivated crops accelerate erosion of soils on slopes and since soils which are low in organic matter are more erosive than soils containing a high proportion of this material, row crops, such as corn, cotton, kafir, and cowpeas, have had a very destructive effect on soil fertility. The decline in the production of cotton is closely associated with the reduction in soil fertility, as determined by chemical analyses of 13 samples of culti-

[5] This section of the report was written by H. J. Harper, professor of soils, agronomy department, Oklahoma Agricultural and Mechanical College.

vated soil which were compared with samples of virgin soil collected from adjacent areas in meadow, pasture, or forest. The results of these analyses are given in table 6.

TABLE 6.—*Losses of plant nutrients in soils in Carter County, Okla., as a result of cultivation*

[Average of 13 comparisons]

Condition of soil	Nitrogen	Phosphorus	Organic matter
	Pounds [1]	*Pounds* [1]	*Pounds* [1]
Virgin	3, 175	765	72, 400
Cropped	1, 600	650	36, 800
Loss through cultivation	1, 575	115	35, 600

[1] Pounds per acre in soil 6⅔ inches deep.

Fifty percent of the original organic matter and nitrogen has disappeared from the cultivated soils as a result of tillage and soil erosion. The loss of phosphorus has not been so great as that of nitrogen, but some loss has occurred. Although the availability of plant nutrients in a soil is more important than the total quantity of the different elements present, information obtained from total analyses is significant when differences are as great as those shown in table 6, because they indicate that the system of soil management must be changed if agriculture is to continue an important enterprise in this county.

The availability of phosphorus in these soils is an important factor in soil improvement. Soils well supplied with this important plant nutrient will produce large crops of legumes which can be used to increase the content of nitrogen and organic matter in the soil. Erosion has not reduced the quantity of available phosphorus in some of the soils, because the subsurface layers contain as much readily available phosphorus as the surface layers. In many other soils, however, the quantity of available phosphorus in the surface layer is high and the quantity of available phosphorus in the subsoil is low; consequently, erosion will reduce the available-phosphorus content of the surface soil in the cultivated fields unless measures to avoid this result are taken. A total of 203 samples of surface soil collected from different parts of the county have been analyzed for readily available phosphorus by extracting 1 part of soil with 10 parts of fifth-normal sulphuric acid. The results show that 20 of the samples analyzed were very high in readily available phosphorus, 42 were high, 19 were medium, 40 were low, and 82 were very low. Phosphate fertilizer can be recommended for soils containing a medium supply of readily available phosphorus when crops like alfalfa or vegetables are grown. Soils which are low or very low in available phosphorus, however, are frequently deficient in other plant nutrients, such as calcium and nitrogen, since the total nitrogen in cultivated fields in this area is declining rapidly as a result of unwise soil management. Phosphate fertilizer will be needed also on many soils, in order to increase the growth of legume crops which should be used more extensively in cropping systems.

Legumes which grow during fall and spring develop more nodules on their roots than those that grow in the summer; consequently, hairy vetch, sweetclover, and alfalfa are superior to soybeans, mung beans, and cowpeas for soil improvement. Experiments indicate that lack of moisture and high temperatures are responsible for the small number of nodules on the roots of summer-grown legumes. Nodule development is more abundant in sandy soils than in fine-textured soils. Legumes planted in rows and cultivated do not increase the nitrogen content of the soil when the crops are removed; consequently, cropping systems should be used which will return a maximum quantity of high-nitrogen residues to the soil. Cropping systems for different soil types will not be the same. Soils which have impervious clay subsoils or those which do not absorb water readily should be used for the production of small grains.

The following rotation is adapted to soils where wind erosion and overflows are not serious problems. Oats are planted in 14-inch rows, and sweetclover is drilled across the rows of oats about 3 or 4 weeks after the oats are planted; the sweetclover is allowed to mature the second season, and a seed crop is harvested or the crop pastured until time to prepare a seedbed for fall planting; two or three crops of wheat or barley can be grown, after which the land is again seeded to oats and sweetclover. If the soils are acid, lime will be needed in order to correct the acidity and insure maximum yields of sweetclover. Wide-row planting of small grains is essential for the success of this system.

The problem of pasture is an important one in many parts of the county. Where native grass supplies grazing only during summer, crops to provide grazing during late fall and early spring are needed. On fine-textured soils with clay subsoils, a rotation with wheat or winter barley and hairy vetch is recommended. These crops can be grown on acid soils because they tolerate a medium acid condition. On such soils, a 2-year rotation providing for planting equal acreages alternately in wheat and hairy vetch is as follows: The vetch is drilled at the rate of 15 pounds an acre about September 15, or as soon as moisture conditions are favorable in September, and winter wheat or winter barley is sown on the other field in time to produce fall and winter pasture; animals are removed from the small-grain field about March 1, or as soon as the vetch can be pastured in the spring, and hairy vetch is then planted on the land previously in small grain, and small grain is drilled on land previously in vetch. Vetch should be plowed under before it produces a seed crop.

A good crop rotation for sandy soils depends on the type of farming practiced. Surface cover is exceedingly important in order to reduce wind erosion to a minimum. The following rotation provides a vegetative cover in the winter and spring when wind erosion is severe, and requires four fields of approximately equal acreage: Rye followed by hairy vetch in the fall, which is pastured, or a seed crop produced, after which Sudan grass can be planted; grain sorghums are grown in the third season; and cotton or cowpeas are grown in the fourth season. Rye is planted following the cowpeas or cotton, and the rotation begins again. These crops are adapted to comparatively poor soils, but a phosphate fertilizer should be applied in the row at the time cotton is planted in order to increase

the production of this crop. The residual effect of the phosphorus will also increase the yield of the other crops in the rotation.

Soil acidity is not an important problem on many soils in this county because the subsurface material on which most of the soils have developed is not acid. Of the 259 samples of surface soil tested for acidity, 61 contained enough lime so that they were basic in reaction, 80 were neutral, 56 were slightly acid, 29 were slightly + acid, 25 were medium acid, 2 were medium + acid, and 6 were strongly acid. The growth of alfalfa, sweetclover, and many garden crops is limited when soils are acid. Slightly acid surface soils over slightly acid subsoils are not favorable for the growth of sweetclover, which is an important legume for soil improvement in this section, although slightly acid soils frequently produce a good growth of sweetclover without treatment when the subsurface layers contain a good supply of lime. Medium to strongly acid soils are frequently very low in available phosphorus. Crop improvement on such soils requires the purchase of fertilizer and is more expensive than on soils which contain a good supply of lime and are high in available phosphorus but are deficient in organic matter because of soil erosion or continued cropping without the use of legumes.

A study of the effect of rate of application of fertilizer on the yields of cotton on Durant fine sandy loam during the period 1930 to 1936 is given in table 7.

TABLE 7.—*The effect of rate of application of fertilizer on the production of cotton on Durant fine sandy loam at Lone Grove, Okla., 1930–36*

Fertilizer used	Amount used per acre	Yield per acre of seed cotton in—							
		1930	1931	1932	1933	1934	1935	1936	Average
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
None	----------	252	1,023	580	505	299	317	334	473
4-12-4	200	333	1,314	739	577	274	333	436	572
	300	348	1,395	741	533	261	372	449	585
	400	342	1,455	784	607	267	504	396	622

The fertilizer was applied at the rates of 200, 300, and 400 pounds an acre in the row and mixed with the soil at the time the seed was planted. When the price of cotton is normal, from 100 to 200 pounds of fertilizer should be applied in the row and mixed with the soil before the cotton is planted. Climatic conditions were unfavorable for cotton production in 3 of the 7 years of this experiment; and the proper use of fertilizer in a section where unfavorable climatic conditions prevail is exceedingly important. The greatest proportionate increase in yield from fertilizer application to cotton is obtained on sandy soils with friable sandy clay subsoils.

Experiments conducted with corn on upland soil near Lone Grove indicate that this crop on Durant fine sandy loam does not respond to commercial fertilizer and that yields are determined largely by climatic conditions. Available moisture is an important factor in crop production, and the type of soil must be considered before soil treatments are recommended. There is some indication that winter barley should be grown more extensively to replace corn as a feed crop on

heavy upland soils. Michigan winter barley is well adapted to highly productive soils and should be grown more extensively on the dark-colored Prairie soils and on bottom lands in rotation with alfalfa. The use of small grain is the best method for the control of Johnson grass, which can be destroyed by intensive summer fallow. Although corn usually follows alfalfa, the use of winter barley will eliminate the hazards which occur from severe summer drought, which frequently reduces corn yields to a very low point. The most important limiting factors in the production of barley are winter injury and excessive rainfall at harvest.

A study of the chemical composition of several typical soil profiles collected is given in table 8.

TABLE 8.—*Chemical composition of soils in Carter County, Okla.*[1]

DARK PRAIRIE SOILS

Soil type and sample no.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Summit clay loam:		*Inches*		*Percent*	*Percent*	*Percent*	*Pounds per acre*
5248	SW¼ sec. 35, T. 2 S., R. 1 E.	0–14	6.7	2.96	0.152	0.041	48
5249		14–22	7.3	1.58	.077	.027	32
5250		22–34	8.2	1.17	.068	.032	112
5251		34–52	8.4	.59	.028	.035	200
5252		52–60	8.5	.42	.022	.033	480
Durant loam:							
3405	SW¼SW¼ sec. 36, T. 3 S., R. 2 W.	0–8	6.1	1.45	.076	.024	2
3406		12–35	6.1	1.10	.066	.030	0
3407		35+	6.8	.52	.040	.029	0
Durant loam:							
3390	SW¼ sec. 7, T. 5 S., R. 2 E.	0–14	5.9	2.00	.087	.035	0
3391		14–30	6.5	.60	.057	.024	0
3392		30+	7.2	2.22	.046	.046	0
Kirkland loam:							
3409	SE¼SW¼ sec. 19, T. 5 S., R. 3 W.	0–22	6.9	1.62	.071	.048	2
3410		22–40	7.8	1.05	.051	.033	2
3411		40–60	8.9	.70	.036	.029	16
3412		60+	9.0	.37	.026	.029	20
Durant clay loam:							
3426	SW¼SW¼ sec. 2, T. 3 S., R. 1 W.	0–14	7.4	4.65	.106	.043	52
3427		14–21	6.4	1.20	.054	.024	2
3428		21–54	8.7	1.77	.034	.045	96
3429		54+	8.9	.50	.019	.053	224
Ellis clay, eroded phase:							
3430	NE¼NW¼ sec. 15, T. 3 S., R. 1 E.	0–4	8.5	2.77	.015	.054	288
3431		4+	8.5	1.10	.079	.055	320
Zaneis very fine sandy loam:							
3398	SE¼SE¼ sec. 31, T. 4 N., R. 3 W.	0–8	6.2	1.30	.069	.031	0
3399		8–16	7.1	.35	.043	.027	2
3400		16–40	7.0	.35	.027	.022	0

LIGHT-COLORED UPLAND SOILS

Soil type and sample no.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Conway fine sandy loam:							
3414	SE¼SW¼ sec. 19, T. 5 S., R. 1 E.	0–5	6.9	3.32	0.111	0.031	8
3415		5–16	6.8	.60	.016	.032	0
3416		16–30	5.8	.60	.030	.033	0
3417		30+	5.8	.65	.030	.033	0
Conway fine sand:							
3418	SW¼SW¼ sec. 26, T. 5 S., R. 2 W.	0–5	6.0	1.30	.036	.030	4
3419		5–14	6.5	.45	.009	.030	0
3420		14+	6.6	.30	.011	.022	0
Hanceville fine sandy loam:							
3394	SE¼ sec. 20, T. 4 S., R. 3 E.	0–6	6.6	.75	.070	.023	0
3395		6–10	5.9	1.10	.024	.016	0
3396		10–20	4.8	.52	.031	.011	0
3397		20+	5.3	.25	.014	.012	0

[1] These analyses were made at the Oklahoma Agricultural and Mechanical College.

TABLE 8.—*Chemical composition of soils in Carter County, Okla.*—Continued

SOILS OF THE TERRACES AND BOTTOM LANDS

Soil type and sample no.	Location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
		Inches		*Percent*	*Percent*	*Percent*	*Pounds per acre*
Verdigris clay:							
3421	SE¼ sec. 36, T. 3 S., R. 1 E.	0–10	8.2	2.82	0.166	0.052	152
3422		10–22	7.1	1.75	.084	.033	44
3423		22+	8.6	1.10	.054	.019	200
Teller very fine sandy loam:							
3401	SE¼SE¼ sec. 18, T. 3 S., R. 3 E.	0–20	8.3	1.65	.070	.050	192
3402		20–60	7.3	.52	.031	.043	288
Verdigris clay loam:							
3424	SE¼SW¼ sec. 23, T. 4 S., R. 2 W.	0–10	8.0	1.75	.017	.045	76
3425		10+	6.1	2.93	.062	.43	8
Yahola very fine sandy loam:							
3403	SW¼NW¼ sec. 16, T. 3 S, R. 3 E.	0–14	8.5	1.65	.074	.037	176
3404		14+	8.5	.80	.049	.040	144

One of the outstanding differences in these analyses is the very small quantity of available phosphorus in the light-colored upland soils and in the soils of the Durant and Zaneis series, compared with the large quantity of readily available phosphorus in alluvial soils and in the dark-colored Prairie soils derived from calcareous parent material. The average content of organic matter in the soils is low. In many instances, the soils are comparatively shallow because the rate of erosion is more rapid than the rate of soil formation from the underlying material. Torrential rainfall, rapid run-off, and limited penetration of moisture are partly responsible for the shallowness of many areas of soils. The high rate of evaporation and transpiration due to the high summer temperatures are other factors accounting for the slight depth of parent material in many areas where the relief is rolling or rough. The profiles of the Conway soils are thoroughly leached, and the subsoils have a low pH value.

MORPHOLOGY AND GENESIS OF SOILS

The soils of Carter County have developed in a humid climate. Under a forest vegetation soils of the Red and Yellow soils region have been produced, and under a grass vegetation soils of the southern Prairie soil region have been produced. The broader differences in the soils of this county are the result of differences in native vegetation and parent materials; minor differences are the result of the varied relief and erosion.

As a rule, the lighter textured soils are developed from sandstone, are forested, and have the characteristics of the podzolized Red and Yellow soils. The normal soil color is grayish brown in the surface layer, yellowish brown in the subsurface layer, and red or yellow in the subsoil. In the flatter areas or divides, where drainage and aeration have not been thorough, the subsoil is yellow instead of red. The Red and Yellow soils are low in organic matter.

The Prairie soils are developed mostly from fine-grained sandstone, shales, or limestone, and the mature soils are dark. They have a high organic-matter content. The immature Prairie soils are influenced by the color of their parent materials. Most of the shales are gray or brown, but some are red. One important type of Prairie soil has a surface texture only slightly, if at all, heavier than the texture of the podzolized forested soils.

A discussion of the distribution of soils in this county is very closely allied with a discussion of geology. As a general rule, the more recent formations are sandstones underlain by interbedded sandstone and shales. Below these are heavy shales underlain, in turn, by limestones. Folding of the earth's crust has taken place to such an extent that the limestones are exposed in the northern part of the county, forming the extensive areas of rough stony land of the Arbuckle Mountains. The exposed areas in the southern part comprise the Criner Hills. The fold of the Arbuckle Mountains is in an almost east-west direction, the greater part lying north of the Murray County line. The rough stony areas of limestone are bordered by an area of heavy dark shales which have weathered into dark Prairie soils. These shales range from slightly calcareous to noncalcareous. The fold of the Criner Hills extends in a northwest-southeast direction. The limestones are exposed here also as rough stony land and are surrounded by the heavy shales that overlie them. In a few places the soil evidently has been developed from limestones.

Other folds occur in the vicinity of Ardmore and southeastward. Both sandstones and shales are exposed in these folds, but the limestones are not. The folding has resulted in the formation of a series of sandstone ridges and shale valleys lying in a northwest-southeast direction. In some places the narrow sandstone ridges extend for several miles across the county. Many of the ridges are so narrow that they can be shown only as rock outcrops on the soil map.

Besides these areas of heavy Prairie soils, areas of lighter textured Prairie soils are intermingled with the sandy forested soils, particularly in the western part of the county. Possibly these sandy soils support a prairie type of vegetation because of the higher content of lime in the parent material.

Mechanical analyses of samples of two soils are given in table 9.

TABLE 9.—*Mechanical analyses of samples of two soils from Carter County, Okla.*

Soil type and sample no.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Durant loam:	*Inches*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
451732	0- 2	0.6	0.8	2.1	22.0	23.3	34.6	16.7
451733	2-14	.2	.8	2.5	26.1	20.0	30.5	19.9
451734	14-30	.1	.3	1.3	13.5	11.0	24.2	49.5
451735	30-50	.2	.4	1.4	15.3	11.9	23.2	47.7
Kirkland loam:								
451712	0- 3	.2	.3	.5	16.4	28.7	38.2	15.8
451713	3-22	.1	.3	.9	15.6	21.9	45.9	15.3
451714	22-40	.1	.2	.6	10.0	12.0	31.2	46.0
451715	40-59	.4	.5	.7	9.7	11.1	33.9	43.6
451716	59-70+	.8	1.3	1.1	12.3	12.9	28.1	43.5

Forested soils developed from sandstone have been classified in the Hanceville and Conway series. The Hanceville soils are characterized by sloping to rolling relief, and they are thoroughly drained and aerated. Conway soils occur on flats and smooth divides where drainage is not so thorough, but they are not poorly drained.

A description of a typical profile of virgin Hanceville fine sandy loam, as observed in the SE¼ sec. 20, T. 4 S., R. 3 E., follows:

0 to ½ inch, grayish-brown mixed leafmold and mineral matter.

½ to 4 inches, dark grayish-brown slightly acid loose friable fine sandy loam, in which no structural lines are present.

4 to 6 inches, grayish-brown or light grayish-brown fine sandy loam or loamy fine sand.

6 to 8 inches, gray fine sand or loamy fine sand, which is lighter in texture and color than the overlying layer and contains a few spots of yellowish-brown heavier material.

8 to 16 inches, red or yellowish-red very friable sandy clay which breaks into irregular granules one-fourth inch or less in diameter and contains a few yellow or reddish-yellow mottlings. The cleavage planes are not shiny.

16 to 35 inches, material similar to that in the layer above but faintly mottled with gray. The predominant color is yellowish red.

Below a depth of 35 inches and extending to bedrock, a layer of predominantly gray fine sandy loam mottled with brown, yellowish brown, and yellowish red, in which there are small black concretions of unweathered sandstone remnants. This layer rests on sandstone bedrock at a depth ranging from 5 to 10 feet.

The profile is slightly acid throughout.

The surface soil in cultivated areas is generally grayish brown to a greater depth—8 or 10 inches. The yellowish-red sandy clay is exposed in many places by erosion or plowing. The soil erodes very easily when the native timber is removed.

Associated with Hanceville fine sandy loam but occurring on smoother divides is Conway fine sandy loam. Following is a description of a typical profile of virgin Conway fine sandy loam, as observed in the SE¼SW¼ sec. 19, T. 5 S., R. 1 E:

0 to ½ inch, dark grayish-brown leafmold containing enough mineral matter to give it the texture of fine sandy loam.

½ to 5 inches, dark grayish-brown loose friable slightly acid fine sandy loam in which no cleavage lines are present.

5 to 16 inches, brown or slightly yellowish brown loose fine sandy loam. A few streaks of dark material occur in the upper part of the layer, apparently washed down cracks and root holes from the overlying layer.

16 to 30 inches, yellow fine sandy clay which is friable in most places and tends to break into granules about one-fourth inch in diameter.

Below a depth of 30 inches and extending to bedrock is a layer of yellow, gray, and red mottled fine sandy clay or clay loam, slightly heavier and more compact than the layer above, and composed largely of weathered sandstone.

The unweathered sandstone in most places lies at a depth ranging from 10 to 15 feet.

The subsoil and underlying parent material are slightly or distinctly acid.

The greater part of this soil has developed over sandstone probably of Permian age, but part of it has developed over sandstones that geologists consider belong to Pennsylvanian and Cretaceous ages.[6]

[6] See footnote 3, p. 9.

Associated with Conway fine sandy loam, with similar relief and apparently developed from practically the same type of parent material, is a Prairie soil which has been classified as Durant fine sandy loam. Possibly the sandstone is slightly finer grained and may contain some lime, thereby making conditions more favorable for a grassy vegetation. The vegetation, of course, has had an important effect in delaying the removal of lime by leaching.

A description of a typical profile of Durant fine sandy loam, as observed in the SW¼SE¼ sec. 35, T. 3 S., R. 2 W., is as follows:

0 to 3 inches, dark grayish-brown faintly laminated friable fine sandy loam, containing a few small ferruginous sandstone gravel. The color of the material is only slightly lighter when it is crushed.

3 to 13 inches, very dark grayish-brown slightly columnar fine sandy loam or heavy fine sandy loam. The material breaks into irregular clods with dark surfaces which are much lighter when crushed—a yellowish brown. The material in the upper part of this layer in some places breaks into horizontal plates about one-half inch thick. Worm holes and casts are numerous throughout.

13 to 35 inches, yellow and brown mottled clay loam containing numerous black pellets or concretions of ferruginous sandstone which are probably remnants of the original sandstone that have resisted weathering. Many reddish-brown mottlings are present in this layer, particularly where the texture is slightly heavier. Root and worm holes are lined with darker material from the overlying layers.

35 to 60 inches+, brown, yellow, red, and gray mottled weathered sandstone. The material contains irregular-shaped gravel of unweathered sandstone, which do not have sharp edges or angles. These gravel are yellow on the surface and black in the center. The layer rests on unweathered sandstone at a depth ranging from 5 to 8 feet.

A soil similar to Durant fine sandy loam but heavier textured has been classified as Durant loam. It is apparently developed from a fine-grained sandstone or a slightly sandy shale. Durant clay loam, also similar to Durant fine sandy loam, has developed from slightly calcareous shales. It is a dark heavy Prairie soil with a granular but noncalcareous surface soil. A description of a typical profile of Durant clay loam, as observed 2 miles west of Springer, follows:

0 to 5 inches, very dark grayish-brown or almost black friable noncalcareous granular clay loam containing a few cherty gravel. The material breaks into friable irregular granules ranging from one-eighth to one-fourth inch in diameter, which are slightly lighter when crushed.

15 to 22 inches, mottled brown and rusty-brown noncalcareous clay loam which is plastic when wet. It breaks into angular granules, the surfaces of which are not shiny.

22 to 54 inches, dark-gray or drab clay loam containing a few rusty-brown mottlings and small cherty gravel. It breaks into irregular granules with slightly shiny surfaces.

54 to 70 inches+, gray and yellow or ocher-yellow mottled clay loam which is weathered slightly calcareous shale of Pennsylvanian age. In many places the shale seems to be noncalcareous.

Associated with this soil on steeper slopes is a shallow slightly calcareous Prairie soil that is little more than poorly weathered shale. It is designated Ellis clay, eroded phase. Also associated with Durant clay loam is an inextensive dark soil developed from limestone that has been correlated as Denton clay.

In the southwestern part of the county the calcareous red shales of the Permian Red Beds have developed into soils. Kirkland loam, a mature soil developed from this formation, resembles Durant loam

in the surface soil. It has, however, a heavy claypan subsoil, and the lower part of the subsoil contains much shale of the Permian Red Beds. A description of a typical profile of Kirkland loam, as observed in the SE¼SW¼ sec. 19, T. 5 S., R. 3 W., follows:

0 to 3 inches, grayish-brown loose faintly laminated noncalcareous friable loam.
3 to 22 inches, dark grayish-brown very fine sandy loam or silt loam, which is grayish brown when dry. The material in this layer is noncalcareous, rather loose, and friable under ordinary moisture conditions. It breaks into large cubical blocks when dry. Worm casts and worm holes are numerous.
22 to 40 inches, very dark brown or dark chocolate-brown heavy clay which is reddish brown when crushed. It breaks with characteristic clay cleavage, into flattened or irregular granules or structural aggregates that have shiny surfaces. The material in this layer is noncalcareous.
40 to 59 inches, a horizon differing from the one above in color only. It is dark chocolate brown and contains a few red splotches and some calcareous spots.
59 to 70 inches, red calcareous clay or clay loam, which consists largely of weathered shales of the Permian Red Beds. A few dark streaks and spots from the above layer are present. The material is tough and plastic when wet.

Associated with Kirkland loam is Zaneis very fine sandy loam. This Prairie soil is slightly more red in the surface layers, and the red subsoil, which is not a claypan, is reached at a depth ranging from 8 to 18 inches. Areas of the Zaneis soil range from rolling to steep. On the steeper slopes is a red soil, designated as Vernon clay, which is little more than weathered red shale.

SUMMARY

Carter County, which has a total area of 831 square miles, is in south-central Oklahoma near the western edge of the humid region. It comprises both prairie and forested land. The relief ranges from smoothly undulating to strongly rolling, and in some sections the land is rough and stony, as in the Arbuckle Mountains in the northern part.

The climate is mild, and the growing season for tender vegetation averages 239 days a year. The average annual rainfall of 36.06 inches is usually sufficiently well distributed to provide adequate moisture for crops.

About 27 percent of the land in the county is available for cultivation, according to the census of 1935, although the cropland harvested in 1934 occupied only 79,322 acres, or slightly less than 15 percent of the total land area of the county. Of the cropland harvested in 1934, about 30 percent was devoted to cotton, 30 percent to hay and coarse forage, and 18 percent to corn. A little more than 10 percent was used for the production of oats and less than 6 percent for grain sorghums. The average yields of all crops are rather low, owing to the low productive capacity of many of the soils. Highly fertile soils are less extensive than the moderately or less productive soils. About 15 percent of the land is nonarable and is used only for grazing livestock.

The soils of the county are arranged in four groups on the basis of their characteristics and suitability for agriculture. These are: (1) dark Prairie soils which are for the most part deep soils; (2)

light-colored upland soils which are sandy and forested; (3) soils of the terraces and bottom lands; and (4) nonarable soils and land.

The Prairie soils are dark and are moderately heavy or rather light in texture. Those having a deep normal development are productive. They are members of the Durant, Denton, Summit, and Newtonia series. The most extensive are the Durant soils. They are used extensively for the production of cotton, corn, oats, grain sorghums, and forage crops, and yields are somewhat higher than those obtained on most other soils of the county. Riverton gravelly loam, Vernon clay, and Ellis clay, eroded phase, are thin and eroded Prairie soils. Most of this land is not cultivated but is used only for pasture.

The light-colored upland soils, which include Hanceville fine sandy loam, Conway fine sandy loam, and Conway fine sand, are developed, under a post oak forest vegetation, from highly siliceous sandstones. They are leached considerably, and in places the land is severely eroded. Although only moderately productive, they respond well to improvement and fertilization. The farm crops ordinarily produced in this section are grown on a very large proportion of these soils, although the soils are better suited to the production of fruits, vegetables, peanuts, and berries, of which considerable quantities are grown. These soils are fairly extensive.

The soils of the terraces and bottom lands comprise smooth nearly flat areas in stream valleys, flood-plain bottom lands, and smooth flat benches no longer overflowed. Of these Teller very fine sandy loam, Teller fine sandy loam, and Brewer clay, occurring on the smooth terraces, are of considerable importance. They are highly productive and do not erode readily. Teller very fine sandy loam is considered the most valuable soil in the county. The Verdigris, Pope, and Yahola soils of the stream-bottom flood plains also are highly productive and especially suited to corn, alfalfa, feed crops, and pecans, although average yields are lowered by occasional overflows which damage or destroy crops.

The nonarable lands consist chiefly of very stony steeply sloping or deeply eroded lands or rough lands entirely unsuited to cultivation. These are rough stony land (Denton soil material) which comprises most of the Arbuckle Mountains, consists of limestone, and supports a good growth of native grasses utilized in raising range livestock, chiefly beef cattle; rough stony land (Hanceville soil material), a rough sandstone land, which affords less valuable pasturage than the Denton soil material and produces trees for fuel; and Hanceville fine sandy loam, eroded phase, which also is forested and has little value other than for pasture.

U. S. GOVERNMENT PRINTING OFFICE 1938

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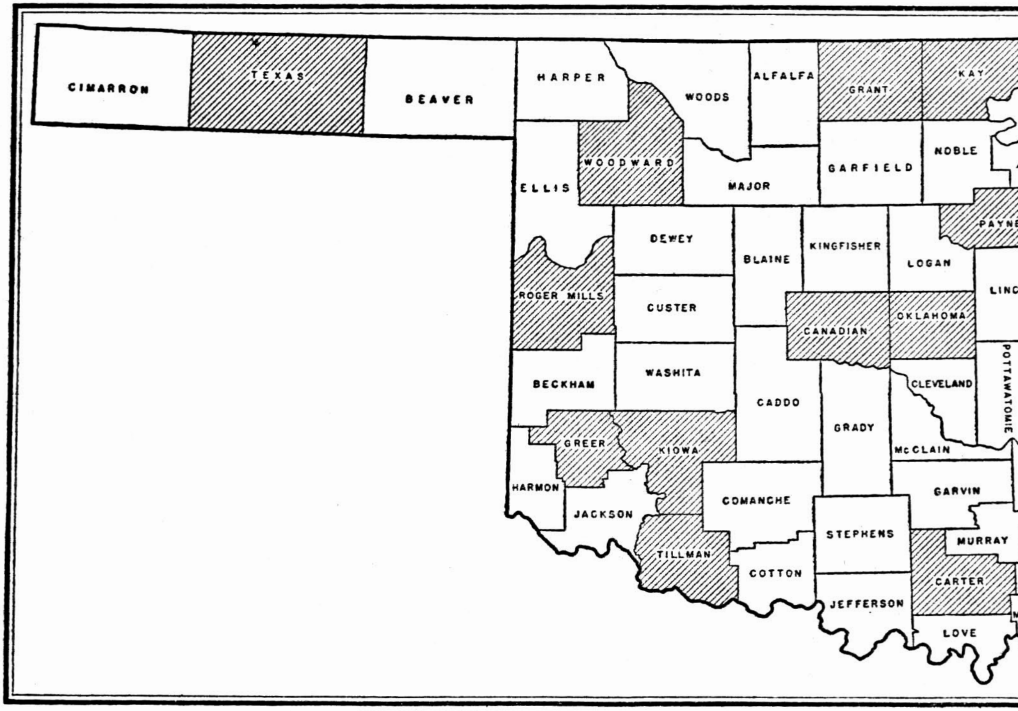

Areas surveyed in Oklahoma shown by shading. Detailed surveys shown by north

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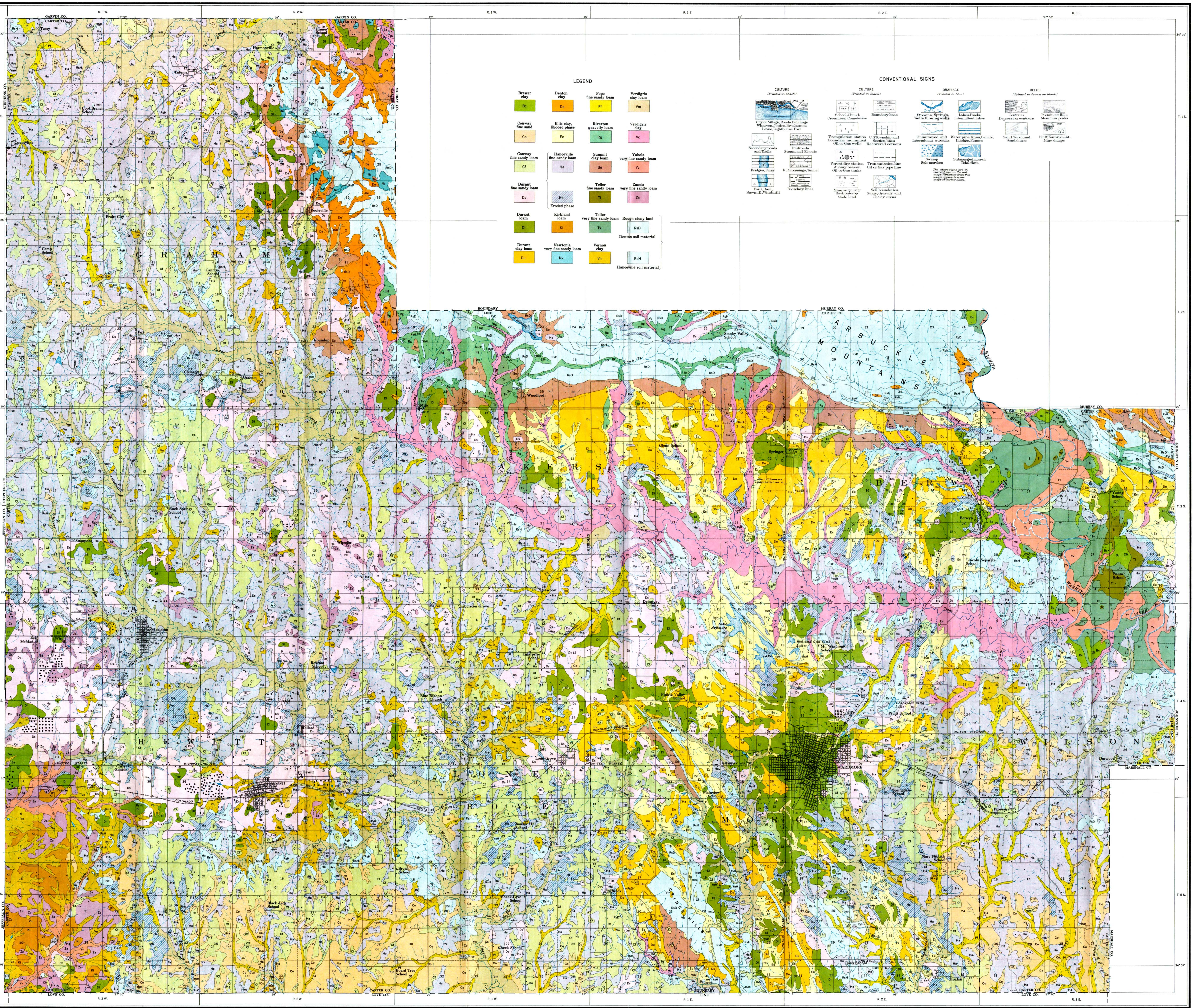
SOIL MAP
CARTER COUNTY
OKLAHOMA

OKLAHOMA AGRICULTURAL EXPERIMENT STATION
C. P. BLACKWELL, DIRECTOR
AGRONOMY DEPARTMENT
H. E. WINTERS, HEAD OF DEPARTMENT



W. T. Carter, Inspector, District 4.
Soils surveyed by E. G. Fitzpatrick, U. S. Department of Agriculture, in charge, and W. C. Boatright, Oklahoma Agricultural Experiment Station.

Scale 1 inch - 1 mile

Field Operations
Bureau of Chemistry and Soils
1933